Background: Both long and short sleep durations have been associated with negative health outcomes in middle-aged and older adults. This study assessed the relationship between sleep duration and self-rated health in young adults.

Methods: Using anonymous questionnaires, data were collected from 17,465 university students aged 17 to 30 years who were taking non–health-related courses at 27 universities in 24 countries. The response rate was greater than 90%. Sleep duration was measured by self-report; the health outcome was self-rated health; and age, sex, socioeconomic background, smoking, alcohol consumption, body mass index, physical activity, depression (Beck Depression Inventory), recent use of health services, and country of origin were included as covariates.

Results: Sixty-three percent of respondents slept for 7 to 8 hours; 21% were short sleepers (6%, <6 hours; 15%, 6-7 hours); and 16% were long sleepers (10%, 8-10 hours; 6%, >10 hours). Compared with the reference category (7-8 hours), the adjusted odds ratio of poor health was 1.56 (95% confidence interval [CI], 1.22-1.99) for respondents sleeping 6 to 7 hours and 1.99 (95% CI, 1.31-3.03) for those sleeping less than 6 hours. The same significant pattern was seen when the results were analyzed separately by sex. When respondents from Japan, Korea, and Thailand (characterized by relatively short sleep durations) were excluded, the adjusted odds ratios were 1.33 (95% CI 1.03-1.73) and 1.62 (95% CI, 1.06-2.48) for those sleeping 6 to 7 hours and less than 6 hours, respectively. There were no significant associations between self-rated health and long sleep duration.

Conclusion: Our data suggest that short sleep may be more of a concern than long sleep in young adults.

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Mortality rates are increased in persons who report sleeping either less than 7 hours or more than 8 hours in comparison with those sleeping approximately 7 to 8 hours.1,2 Both short and long sleep durations have been associated with increased risk of coronary heart disease and type 2 diabetes3,4 as well as with daytime sleepiness and waking unrefreshed.5 Short but not long sleep duration has been identified as a risk factor for hypertension.6

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Research into sleep duration and health has largely focused on middle-aged and older adults, and it is not known whether similar patterns are observed in earlier years, before most chronic illnesses are established. The present study investigated the relationship between sleep duration and health in a large sample of young adults from 24 countries using self-rated health as the outcome. We hypothesized that self-rated health would be poorer in respondents who slept less than 7 hours or more than 8 hours than it would be in those who slept 7 to 8 hours. Other factors known to influence either sleep duration or self-rated health, including age, depressive symptoms, recent health problems, socioeconomic background, body mass index, smoking, alcohol consumption, and physical activity, were taken into account.8,13

STUDY POPULATION

Data were analyzed from the International Health and Behavior Study, an anonymous questionnaire study of health behaviors, attitudes, and risk awareness in university students, which was performed in 24 countries between 1999 and 2001. It was based on the European Health Behavior Survey, a study of 16,483 students from 21 European countries conducted between 1989 and 1991, which was designed to elucidate the wide variation across countries in the prevalence of health behaviors and their associations with beliefs and risk awareness.14 The International Health and Behavior Study was carried out with a network of collaborators in participating countries, and the questionnaire used for data collection was developed in English and then translated and back-translated into 19 languages (Bulgarian, Chinese, Dutch, Flemish, French, German,
Greek, Hungarian, Icelandic, Italian, Japanese, Korean, Mandarin, Polish, Portuguese, Romanian, Slovakian, Spanish, and Thai. One university took part in each of 21 countries, and 2 universities took part in the remaining 3 countries. The selection of universities was not random but was designed to compare public universities of similar academic standing in different countries. The same European universities were involved as in the European Health Behavior Survey to analyze trends over time. \(^1\)

Participants were students aged 17 to 30 years who were not studying medicine or health-related topics. A variety of students were involved, including those studying physical sciences, engineering, medicine or health-related topics. A variety of students were included in classes, and participation rates in most countries were higher than 90%. Students were told that the survey concerned activities related to health and that an international comparison was being performed, but no further details were given. A total of 17,465 respondents were included, and the distribution across countries is detailed in Table 1.

### MEASURES

Participants were asked, “On average, how many hours of sleep do you get in a 24 hour period?” Responses were divided into 5 categories: very short sleep (<6 hours), short sleep (6-7 hours), reference category (7-8 hours), long sleep (8-10 hours), and very long sleep (>10 hours). Respondents rated their health with the question, “In general, would you say that your health is excellent, very good, good, fair, or poor?” Self-rated health was converted into a binary outcome for analysis, and poor health was defined as choosing the fair or poor (12%) response categories.

Depressed mood was assessed with the 13-item Beck Depression Inventory, \(^1\) which had good internal consistency (Cronbach \(\alpha\geq0.79\) in every country. Recent use of health services was assessed with a yes or no question—“Do you suffer from any health problems that have led you to visit a doctor or health clinic in the past 4 weeks?”—with 22% responding positively. Socioeconomic background was assessed with measures of the educational attainment of respondents’ parents. Respondents were subsequently categorized into those who had at least 1 parent with a university education (30% of respondents) or those who had no parent with a university education. Smoking, alcohol consumption, body mass index, and physical activity were assessed by questionnaire using previously described measures. \(^2\)-\(^4\)

### STATISTICAL ANALYSIS

Respondents reporting high levels of depression (Beck Depression Inventory score \(\geq19\), \(n=426\)) were excluded from analysis as possible cases of clinical depression because sleep is known to be affected by depression. Individuals reporting exceptionally short (<4 hours) or long (>13 hours) sleep durations were also excluded on the basis that the reports might be unreliable (\(n=143\)). In total, 552 respondents (3.1%) were excluded from analyses. A commercially available software package (Version 13.0; SPSS Inc, Chicago, Ill) was used to obtain values for means and confidence intervals by country. Logistic regression models were fitted to assess the predictive value of sleep duration on self-rated health. The “svylogit” command in Stata (Stata Corp, College Station, Tex) was used to fit regression models, with the country entered as the primary sampling unit to obtain accurate confidence intervals, given the clustered nature of the data. Data were checked for collinearity. Model 1 included sleep duration as the primary predictor together with

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**Table 1. Mean Sleep Duration and Self-rated Health by Country and Sex**

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean Sleep Duration, h (95% CI)</th>
<th>No.</th>
<th>Poor Self-rated Health, %</th>
<th>Mean Sleep Duration, h (95% CI)</th>
<th>No.</th>
<th>Poor Self-rated Health, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>7.69 (7.54-7.84)</td>
<td>244</td>
<td>7.4</td>
<td>7.90 (7.76-7.60)</td>
<td>261</td>
<td>7.3</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>7.81 (7.67-7.93)</td>
<td>336</td>
<td>10.4</td>
<td>8.00 (7.88-8.12)</td>
<td>377</td>
<td>14.1</td>
</tr>
<tr>
<td>Colombia</td>
<td>7.14 (7.02-7.26)</td>
<td>378</td>
<td>4.0</td>
<td>7.24 (7.11-7.37)</td>
<td>325</td>
<td>6.5</td>
</tr>
<tr>
<td>England</td>
<td>7.40 (7.29-7.52)</td>
<td>372</td>
<td>8.3</td>
<td>7.37 (7.24-7.49)</td>
<td>330</td>
<td>10.0</td>
</tr>
<tr>
<td>France</td>
<td>7.55 (7.42-7.68)</td>
<td>312</td>
<td>6.4</td>
<td>7.73 (7.60-7.86)</td>
<td>322</td>
<td>13.4</td>
</tr>
<tr>
<td>Germany</td>
<td>7.39 (7.26-7.52)</td>
<td>309</td>
<td>10.4</td>
<td>7.60 (7.46-7.71)</td>
<td>372</td>
<td>6.5</td>
</tr>
<tr>
<td>Greece</td>
<td>7.86 (7.74-7.98)</td>
<td>350</td>
<td>3.7</td>
<td>7.87 (7.75-7.99)</td>
<td>371</td>
<td>7.5</td>
</tr>
<tr>
<td>Hungary</td>
<td>7.55 (7.39-7.71)</td>
<td>216</td>
<td>8.8</td>
<td>7.55 (7.42-7.68)</td>
<td>323</td>
<td>12.4</td>
</tr>
<tr>
<td>Iceland</td>
<td>7.21 (7.07-7.34)</td>
<td>294</td>
<td>7.1</td>
<td>7.56 (7.43-7.68)</td>
<td>337</td>
<td>6.8</td>
</tr>
<tr>
<td>Ireland</td>
<td>7.21 (6.98-7.44)</td>
<td>97</td>
<td>11.3</td>
<td>7.67 (7.55-7.80)</td>
<td>329</td>
<td>8.2</td>
</tr>
<tr>
<td>Italy</td>
<td>7.58 (7.49-7.67)</td>
<td>641</td>
<td>8.0</td>
<td>7.71 (7.64-7.78)</td>
<td>1092</td>
<td>14.5</td>
</tr>
<tr>
<td>Japan</td>
<td>6.20 (6.03-6.38)</td>
<td>172</td>
<td>38.4</td>
<td>6.09 (5.92-6.26)</td>
<td>186</td>
<td>45.7</td>
</tr>
<tr>
<td>Korea</td>
<td>6.80 (6.64-6.96)</td>
<td>208</td>
<td>35.6</td>
<td>6.86 (6.75-6.97)</td>
<td>440</td>
<td>42.7</td>
</tr>
<tr>
<td>Netherlands</td>
<td>7.79 (7.65-7.92)</td>
<td>275</td>
<td>8.7</td>
<td>7.92 (7.81-8.04)</td>
<td>404</td>
<td>8.9</td>
</tr>
<tr>
<td>Poland</td>
<td>7.24 (7.11-7.37)</td>
<td>312</td>
<td>4.5</td>
<td>7.42 (7.30-7.53)</td>
<td>390</td>
<td>10.5</td>
</tr>
<tr>
<td>Portugal</td>
<td>7.72 (7.61-7.83)</td>
<td>431</td>
<td>10.7</td>
<td>7.84 (7.73-7.95)</td>
<td>431</td>
<td>16.0</td>
</tr>
<tr>
<td>Romania</td>
<td>8.04 (7.91-8.16)</td>
<td>337</td>
<td>12.8</td>
<td>7.72 (7.60-7.84)</td>
<td>365</td>
<td>27.9</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>7.76 (7.66-7.86)</td>
<td>511</td>
<td>8.6</td>
<td>7.59 (7.50-7.68)</td>
<td>663</td>
<td>9.8</td>
</tr>
<tr>
<td>South Africa</td>
<td>7.26 (7.12-7.40)</td>
<td>268</td>
<td>14.2</td>
<td>7.71 (7.57-7.84)</td>
<td>289</td>
<td>12.8</td>
</tr>
<tr>
<td>Spain</td>
<td>8.02 (7.87-8.18)</td>
<td>215</td>
<td>6.8</td>
<td>7.82 (7.68-7.97)</td>
<td>257</td>
<td>7.4</td>
</tr>
<tr>
<td>Taiwan</td>
<td>6.61 (6.43-6.79)</td>
<td>162</td>
<td>18.5</td>
<td>6.51 (6.33-6.68)</td>
<td>171</td>
<td>31.0</td>
</tr>
<tr>
<td>Thailand</td>
<td>6.95 (6.82-7.08)</td>
<td>306</td>
<td>25.2</td>
<td>7.08 (6.88-7.18)</td>
<td>520</td>
<td>23.3</td>
</tr>
<tr>
<td>United States</td>
<td>7.17 (7.07-7.28)</td>
<td>463</td>
<td>4.3</td>
<td>7.08 (7.01-7.15)</td>
<td>1069</td>
<td>4.7</td>
</tr>
<tr>
<td>Venezuela</td>
<td>7.32 (7.19-7.44)</td>
<td>323</td>
<td>2.8</td>
<td>7.31 (7.18-7.44)</td>
<td>309</td>
<td>3.9</td>
</tr>
<tr>
<td>Total</td>
<td>7.45 (7.29-7.60)</td>
<td>7532</td>
<td>10.1</td>
<td>7.49 (7.32-7.65)</td>
<td>9933</td>
<td>13.6</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.
smoking status (current smoker vs nonsmoker), physical activity (sedentary vs physically active), alcohol consumption (1 or more drinks per day vs fewer or none), parental education, body mass index, sex, and age. Model 2 added depression scores and recent physician visits to take account of the effect of psychological distress and acute health conditions. Odds ratios (ORs), 95% confidence intervals (CIs) for ORs, and P values were obtained from logistic regression.

### RESULTS

Average sleep duration among men and women by sex in each country is shown in Table 1, together with the proportion of respondents rating themselves as in poor health. Average sleep durations ranged from 6 hours to more than 8 hours. Overall, 63% of respondents slept for 7 to 8 hours, 21% were short sleepers (6% <6 hours; 15%, 6-7 hours), and 16% were long sleepers (10%, 8-10 hours; 6%, >10 hours). The proportion of respondents who said that they were in poor health averaged 10.1% for men and 13.6% for women.

The effects were the same for men and women, so the results are presented for the 2 sexes combined. Short sleepers were more likely to report poor self-rated health than those who slept for 7 to 8 hours (Table 2). Regression analyses confirmed that men and women who slept less than 7 hours were more likely to be in poor health after adjustment for sex, age, smoking status, physical activity, alcohol consumption, parental education, body mass index, and country of origin (Table 2, model 1). The associations remained significant after additional adjustment for depression scores and use of health services (Table 2, model 2). There were indications of dose-response relationships. Thus, in model 2, the OR for poor self-rated health adjusted for covariates was 1.99 (95% CI, 1.31-3.03) for people sleeping less than 6 hours and 1.56 (95% CI, 1.22-1.99) for those sleeping 6 to 7 hours.

The Asian countries in the survey, particularly Japan, Korea, and Thailand, were notable for having a high proportion of respondents with poor self-rated health as well as short average sleep durations. The analyses were therefore repeated with these countries excluded. The pattern of results remained significant, although the magnitude of effects was reduced, with an adjusted OR of 1.33 (95% CI, 1.03-1.73) for persons sleeping 6 to 7 hours and an adjusted OR of 1.62 (95% CI, 1.06-2.48) for those sleeping less than 6 hours. No significant associations were observed between self-rated health and long or very long sleep durations.

### COMMENT

Short sleep durations were associated with poorer self-rated health in men and women in this large cross-national study, while longer sleep durations were not related to health. Previous research using self-rated health is limited. Segovia et al20 reported that self-rated health was worse in members of a community sample in Canada who slept for either more or less than 7 to 8 hours, but they did not adjust for potential confounders or consider short and long sleep separately. Another study of middle-aged residents of San Diego, Calif, found no relationship between sleep duration and scores on a health-related quality-of-life scale.21

The graded association between short sleep and poorer self-rated health is intriguing. The direction of causality cannot be established in this cross-sectional data set. It is possible that existing poor health causes shorter sleep, but in these relatively healthy young adults, this possibility seems less likely than in older samples, and the association persisted after visits to the physician were controlled for. Alternatively, short sleep times could have a causal role, perhaps contributing to increased daytime fatigue or to a loss of restorative sleep-related biological processes.22 There may also be underlying factors that cause both short sleep and poor health. Although we took a range of correlates of sleep time and poor self-rated health (including socioeconomic background, smok-
ing, regular physical activity, alcohol consumption, body weight, and depressive symptoms) into account, other unmeasured factors may have contributed. Finally, it is possible that changes in mood associated with inadequate sleep cause a negative bias in the evaluation of health status, although the persistence of associations after depressive symptoms are controlled for reduces the likelihood of a negative affectivity bias.

Research involving middle-aged and elderly participants has documented adverse effects from both short and long sleep times, although there are some indications that short and long sleep are related to different health outcomes.\textsuperscript{2,13,14,25-27} The absence of an association between longer sleep and poor health in the present sample goes against this pattern. It is not likely to be a consequence of using self-rated health as the outcome, because clear associations were demonstrated with shorter sleep duration. The age of the participants may be relevant; younger adults typically sleep longer than older individuals, perhaps reflecting primary physiological processes. In this age group, long sleep may not be a sign of pathology.\textsuperscript{26,27}

Causal conclusions cannot be drawn from these cross-sectional findings. The study was not performed with representative samples of young adults from each country, but with university students. They were chosen because we wished to compare “like with like” across nations, and students are a homogeneous, easily identifiable, and accessible group of comparatively healthy young adults. Sleep patterns of general population samples of similar age may be different, although cross-national sleep surveys show a similar distribution to that observed in our study.\textsuperscript{28} University students typically come from relatively privileged backgrounds, so comparatively good self-rated health might be expected. Sleep duration was measured by self-report, which does not necessarily mirror objective sleep times.\textsuperscript{8}

In summary, much of the previous work on sleep and health has centered on the additional mortality burden that is associated with long sleep.\textsuperscript{29} Our data suggest that short sleep may be more of a concern at younger ages. Further research will be needed to establish whether the connection between sleep duration and poor health consistently varies with age, whether this connection can be demonstrated with other health measures, and whether the relationship is causal.

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